REMARKS

Claims 1-18 are currently pending in this application, as amended. Claim 5 has been rewritten in independent form including all of the limitations of the base claim and all intervening claims. Claim 1 has been amended to more particularly point out and distinctly claim the invention by reciting that the moveable valve plate layer is configured to sequentially open and maintain open at least two of the plurality of valve elements. Support for the amendment can be found in the original Specification at paragraph [0038] and in Figs. 1-2. Claim 18 has been amended to correct an antecedent basis error. Accordingly, no new matter is added by the amendments.

Claim Rejections Under 35 U.S.C. § 102(b)

Claims 1-4, 12, 14-15 and 18 have been rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 5,452,878 ("Gravensen *et al.*," hereinafter, "Gravensen"). It is the Examiner's position that Gravensen shows an electrostatic microvalve having one inlet and two independently activated outlets and that the valve is biased closed and activated to open.

Withdrawal of the rejection of claims 1-4, 12, 14-15 and 18 is respectfully requested for at least the following reasons.

Present Invention

The present invention is directed to a normally-closed electrostatic microvalve device of multilayer form including a stationary valve plate layer having a plurality of fluid flow orifices therethrough. The microvalve also includes a moveable valve plate layer comprising a plurality of valve elements to close the fluid flow orifices of the stationary valve plate layer. At least one valve element of the plurality of valve elements is configured to move with a degree of independence from the remaining valve elements of the plurality of valve elements. The moveable valve plate layer is configured to sequentially open and maintain open at least two of the plurality of valve elements and is arranged for deflection under an applied electrostatic force from a normal closed position in which each of the fluid flow orifices of the stationary valve plate layer is closed by a valve element to an open position in which one or more of the valve elements is displaced from the stationary valve plate layer.

Gravesen

Gravesen discloses a miniature actuating device operated by electrostatic force. In particular Fig. 7 shows one embodiment having a first diaphragm 11 and a second diaphragm 21 connected to a carrier 13 by an insulating member 12. The first and second diaphragms 11, 21 form two separate hollow spaces 15, 18 (i.e., bellows) with the carrier 13. The hollow spaces 15, 18 are interconnected by a duct 19. The surface layer 23 inside hollow region 15 is connected to an electrode terminal 16 for actuating the first diaphragm 11 and the surface layer 23 inside hollow region 18 is connected to another electrode terminal 20 for actuating the second diaphragm 21. When the diaphragm 11 moves into the activated state, fluid located in the hollow space 15 escapes into the duct 19 and into the other hollow space 18. When the electrode 16 is deactivated, the fluid acts as a pressure on the first diaphragm 11 to return it to its at rest position. The second diaphragm 21 operates under a similar principle. The disclosed embodiment shown in Figs. 4 and 7 notes that the first and second diaphragms 11, 21 operate alternately.

Patentability of Claim 1

Claim 1, as amended, recites, *inter alia*:

> a moveable valve plate layer comprising a plurality of valve elements to close the fluid flow orifices of the stationary valve plate layer, at least one valve element of the plurality of valve elements being configured to move with a degree of independence from the remaining valve elements of the plurality of valve elements,
>
> the moveable valve plate layer being configured to sequentially open and maintain open at least two of the plurality of valve elements and being arranged for deflection under an applied electrostatic force from a normal closed position in which each of said fluid flow orifices of the stationary valve plate layer is closed by a valve element to an open position in which one or more of the valve elements is displaced from said stationary valve plate layer.

Gravesen fails to disclose, teach or suggest a normally-closed electrostatic microvalve having a moveable valve plate layer comprising a plurality of valve elements to close the fluid flow orifices of the stationary valve plate layer and that the moveable valve plate layer is configured to sequentially open and maintain open at least two of the plurality of valve elements. Gravesen discloses an electrostatic microvalve having two diaphragms that have a fluid

connection between their bellows or hollow regions such that opening one diaphragm causes the other diaphragm to become pressurized toward the closed position. Even in the alternate embodiment, described but not shown, at col. 7, lines 27-29, Gravesen only contemplates a plurality of diaphragms where some are activated and some are at rest. However, Gravesen fails to recognize sequentially opening (and maintaining open) the diaphragms for any reason.

As discussed at paragraph [0038] of the original Specification for the present invention, due to the unique configuration of the microvalve and its associated moveable plate layer, opening the valve elements sequentially results in a decreasing pressure differential across the overall moveable valve plate thereby requiring a decreasing electrostatic force to open subsequently opened valve elements among the plurality of valve elements.

A claim is anticipated under 35 U.S.C. § 102 only if each and every element as set forth in the claim is found expressly or inherently described in a single prior art reference. MPEP § 2131. Further, the elements must be arranged as required in the claim. In re Bond, 910 F.2d 831, 15 USPQ2d 1566 (Fed. Cir. 1990). Thus, in order to anticipate a claim, a single reference must teach each and every element of the claim and the elements of the reference must be arranged as required in the claim.

Gravesen fails to disclose, teach or suggest a normally-closed electrostatic microvalve having a moveable valve plate layer that is configured to sequentially open and maintain open at least two of the plurality of valve elements, as claimed in independent claim 1, as amended. It is therefore, respectfully submitted that claim 1 is not anticipated by Gravesen. Accordingly, it is respectfully requested that the rejection under 35 U.S.C. § 102(b) of amended independent claim 1 and dependent claims 2-4, 12, 14-15 and 18 should be withdrawn.

Claim Rejections Under 35 U.S.C. § 103(a)

Claims 13 and 15-16 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over Gravesen in view of U.S. Patent No. 5,380,396 ("Shikida *et al.*," hereinafter, "Shikida"). The Examiner takes the position that Gravesen discloses nearly all of the claimed valve, but the Examiner acknowledges that Gravesen does not disclose that the microvalve has rectangular orifices or that the valve is made from silicon. The Examiner takes the position that it would

have been obvious to use rectangular orifices as shown in Shikida and to make the valve out of silicon by micromachining techniques that are well known in the art.

Applicants respectfully traverse the rejection of claims 13 and 15-16.

Shikida

Shikida discloses a gas valve, generally formed of silicon, having an actuator which includes a ribbon-like conductive film 1, two film supporting structures 2-1 and 2-2 for supporting both the ends of the film, and upper and lower operating units 3-1 and 3-2 respectively supported by the supporting structures 2-1 and 2-2 for operating the film 1. The film 1 is supported so as to form a S-shaped inflexion portion within the film 1. The film 1 is operated by the operating units 3-1 and 3-2 in such a manner that the curved plane 1-S is moved to cover rectangularly-shaped orifices 13 when a voltage is applied across the operating unit 3-1 and the film 1.

Patentability of Claims 13 and 15-16

Claims 13 and 15-16 depend from independent claim 1. Gravesen fails to disclose, teach or suggest a normally-closed electrostatic microvalve having a moveable valve plate layer comprising a plurality of valve elements to close the fluid flow orifices of the stationary valve plate layer and that the moveable plate layer is configured to sequentially open and maintain open at least two of the plurality of valve elements. Gravesen discloses an electrostatic microvalve having two diaphragms that have a fluid connection between their bellows or hollow regions such that opening one diaphragm causes the other diaphragm to become pressurized toward the closed position. Even in the alternate embodiment, described but not shown, at col. 7, lines 27-29, Gravesen only contemplates a plurality of diaphragms where some are activated and some are at rest. Shikida fails to compensate for the deficiencies of Gravesen. Shikida discloses a gas valve, generally formed of silicon, having a unitary bendable film that is flexed by electrostatic attraction to cover one or more rectangular orifices.

To establish *prima facie* obviousness of a claimed invention, all the claimed limitations must be taught or suggested by the prior art. MPEP § 2143.03.

Even if Gravesen were made of silicon with rectangular orifices, as suggested by the Examiner, it would still not result in Applicants' microvalve as set forth in dependent claims 13

and 15-16. The modified Gravesen valve would include, *at best*, a silicon microvalve having a plurality of diaphragms where some are activated and some are at rest and which cover a plurality of rectangular orifices. In that claims 13 and 15-16 are dependent on claim 1, which is allowable for the reasons discussed above, it is respectfully requested that the rejection under 35 U.S.C. § 103(a) of dependent claims 13 and 15-16 should be withdrawn.

Allowable Subject Matter

The Examiner has indicated that claims 5-11 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Applicants have rewritten claim 5 in independent form including all of the limitations of original independent claim 1. Claims 6-11 remain dependent from claim 5. In view of the foregoing amendments, it is respectfully submitted that claims 5-11 are in are in condition for allowance and it is respectfully requested that the objection to claims 5-11 has been overcome and should be withdrawn.

CONCLUSION

In view of the foregoing Amendment and Remarks, it is respectfully submitted that the present application, including claims 1-18, is in condition for allowance and such action is respectfully requested.

Respectfully submitted,
DIAO XU *et al.*

October 28, 2003 By: Martin G. Belisario
(Date)

MARTIN G. BELISARIO
Registration No. 32,886
AKIN GUMP STRAUSS HAUER & FELD LLP
One Commerce Square
2005 Market Street, Suite 2200
Philadelphia, PA 19103-7013
Telephone: 215-965-1200
Direct Dial: 215-965-1303
Facsimile: 215-965-1210
E-Mail: mbelisario@akingump.com

MGB/JDS